

SECRET

2 March 1955

MEMORANDUM FOR: THE RECORD

SUBJECT : P-134, Heat Transfer Problems

1. This project was established for the purpose of analyzing the problem of heat failure of components in concealed electronic equipment.

2. The adequate dissipation of heat from electronic equipment is a general problem in the electronic industry. Equipment cooling is usually accomplished by providing holes or slots in equipment cases to allow for natural convection heat transfer. Small fans for forced convection cooling are also employed. The problem of cooling becomes of critical importance in the case of equipment required to perform in aircraft at high altitudes. Cooling is difficult because the low pressure air has a low heat capacity. The usual solution is to pressurize the equipment and provide a heat exchanger with forced convection on both the hot side and the cold side or to place the equipment in a pressurized cabin and to cool it via natural or forced convection. The electronic component manufacturers have also eased the cooling problem by providing components capable of operation at relatively high temperatures. In general, most conventional electronic equipment will cool satisfactorily by natural convection if it is not overly confined.

3. However, use of electronic equipment for Agency interests in the field often necessitates concealment and consequently confinement of radio transmitters, amplifiers, tape recorders, and other electronic gear. This problem may be attacked in the four following ways. The first two are essentially preventive methods aimed at keeping the heat that has to be dissipated to a minimum and the remaining two methods attempt to dissipate the heat so as to avoid heat failure of the device.

a. The circuit design of equipment that is to be confined should be such so as to require a minimum power dissipation as heat. Excess power output from a concealed transmitter should be avoided as it requires the dissipation of extra heat. Some circuit designs require more heat dissipation than others to achieve similar results. As an example, the use of a resistor to reduce an alternating current voltage requires considerably more heat dissipation than a transformer.

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b. The circuit design of the equipment should incorporate efficient low heat dissipating components and components of adequate size (adequate power rating) should be used throughout. As an example, the use of a design incorporating transistors instead of tubes would require the dissipation of considerably less heat.

c. Physical arrangement of components within the black box should be such so as to allow adequate local cooling of components avoiding hot spots. As an example, selenium rectifiers should be placed in a vertical position in an "open" section of the box so that they may properly convection cool. Centers of high heat dissipation should be equally spaced so as to provide for better heat equilibrium and avoid very hot areas.

d. Installation of the electronic equipment should provide for a degree of cooling necessary to avoid breakdown of the equipment. Theoretical and practical studies are being planned to develop techniques that will help in the cooling of concealed electronic equipment.

One outstanding case of heat failure of electronic equipment has been recorded. This involved using a resistor to drop the power to a confined wall transmitter from 220V to 110V. The resistor failed after a few hours of operation.

A variation of the heat failure problem is the poor security that results from a concealed hot transmitter or other electronic gear. The heat emitted from the wall may be felt directly or may have effects which, over a period of time, will betray the location of the equipment. These effects include discoloration of wall paper, paint, etc.

To alleviate this difficulty, more emphasis should be placed on a. and b. in the design of the equipment.

4. In general, it appears that there is no overall cure-all for the problem of heat in electronic equipment. It does appear however that by diligent application of the above listed techniques the problem can be handled satisfactorily

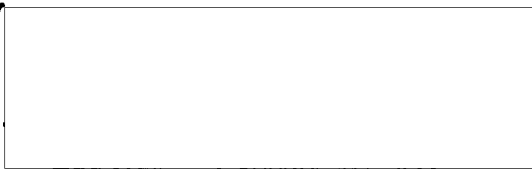
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Distribution:

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